APPENDIX D
SEDIMENT TOTAL MAXIMUM DAILY LOADS

D.1 Sediment

D.1.1 Overview

A percent reduction based on average yearly loading was used as the primary approach for expressing the sediment TMDLs within this document because there is uncertainty associated with the loads derived from the source assessment, and using the estimated sediment loads alone creates a rigid perception that the loads are absolutely conclusive. However, in this appendix the TMDL is expressed using daily loads to satisfy an additional EPA required TMDL element. Daily loads should not be considered absolutely conclusive and may be refined in the future as part of the adaptive management process. It is not expected that daily loads will drive implementation activities.

D.1.2 Approach

The preferred approach for calculating daily sediment loads is to use a nearby water quality gage with a long-term dataset for flow and suspended sediment. Within the Gallatin River watershed, there are several USGS gage stations with extensive discharge datasets but no gage stations with daily suspended sediment measurements. Since sediment loading in the Lower Gallatin TPA is associated with nonpoint sources and storm water-related point sources, the hydrograph is assumed to be a reasonable surrogate for sediment loading to streams (i.e. peak contributions during periods of runoff and high flow). Therefore, mean daily discharge values from 10 years of record (2001-2011) at the gage on the East Gallatin River below Bridger Creek near Bozeman (#06048700) were used to calculate daily sediment values for TMDLs in the Lower Gallatin TPA.

Using the mean of daily mean discharge values from the gage, a daily percentage relative to the mean annual discharge was calculated for each day (**Table D-1**). For each TMDL, the daily load can be calculated by multiplying the daily percentages in **Table D-1** by the total average annual load associated with the TMDL percent reductions in **Section 5.8**. For instance, the total allowable annual sediment load for Bozeman Creek is 1,625 tons. To determine the TMDL for January 1, 1,625 tons is multiplied by 0.09% which provides a daily load for Bozeman Creek on January 1st of 1.5 tons. To conserve resources, this appendix contains the daily loads for Bozeman Creek as an example (**Table D-2** and **Figure D-1**). Daily loads for all other TMDLs can be calculated by multiplying the percentages in **Table D-1** by the values in **Table D-3**. The daily loads are a composite of the allocations, but as allocations are not feasible on a daily basis, they are not contained within this appendix. If desired, daily allocations may be obtained by applying allocations provided in **Section 5.8** to the daily load.

Table D-1. USGS Stream Gage 06048700 (East Gallatin River below Bridger Creek near Bozeman) – Percent of Mean Annual Discharge Based on Mean of Daily Mean Discharge Values for each Day of Record (Calculation Period 2001-10-01 → 2011-09-30)

Day of Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.09%	0.10%	0.10%	0.26%	0.62%	0.95%	0.36%	0.11%	0.09%	0.09%	0.12%	0.10%
2	0.10%	0.09%	0.10%	0.28%	0.59%	0.97%	0.34%	0.11%	0.09%	0.09%	0.12%	0.10%
3	0.10%	0.09%	0.10%	0.27%	0.59%	1.00%	0.32%	0.12%	0.09%	0.09%	0.13%	0.10%
4	0.09%	0.09%	0.11%	0.25%	0.65%	0.95%	0.31%	0.12%	0.08%	0.10%	0.12%	0.10%
5	0.09%	0.10%	0.10%	0.27%	0.65%	0.92%	0.31%	0.11%	0.09%	0.11%	0.12%	0.10%
6	0.09%	0.10%	0.10%	0.33%	0.72%	0.93%	0.29%	0.11%	0.09%	0.11%	0.12%	0.10%
7	0.09%	0.10%	0.10%	0.31%	0.80%	1.05%	0.27%	0.11%	0.09%	0.11%	0.12%	0.10%
8	0.10%	0.10%	0.11%	0.31%	0.83%	1.01%	0.26%	0.11%	0.09%	0.11%	0.14%	0.09%
9	0.10%	0.09%	0.12%	0.33%	0.83%	0.97%	0.24%	0.12%	0.09%	0.11%	0.13%	0.09%
10	0.09%	0.09%	0.12%	0.35%	0.84%	0.97%	0.22%	0.11%	0.11%	0.11%	0.12%	0.10%
11	0.09%	0.09%	0.13%	0.34%	0.82%	1.13%	0.22%	0.11%	0.10%	0.11%	0.12%	0.10%
12	0.09%	0.09%	0.15%	0.36%	0.82%	1.10%	0.21%	0.10%	0.09%	0.12%	0.12%	0.10%
13	0.09%	0.09%	0.19%	0.40%	0.83%	1.02%	0.21%	0.10%	0.09%	0.11%	0.13%	0.10%
14	0.10%	0.09%	0.19%	0.48%	0.89%	0.96%	0.20%	0.10%	0.09%	0.11%	0.12%	0.10%
15	0.09%	0.09%	0.18%	0.51%	0.97%	0.92%	0.18%	0.10%	0.09%	0.12%	0.11%	0.10%
16	0.09%	0.09%	0.18%	0.47%	0.97%	0.89%	0.18%	0.10%	0.09%	0.13%	0.12%	0.09%
17	0.10%	0.09%	0.18%	0.50%	1.02%	0.86%	0.17%	0.10%	0.10%	0.13%	0.12%	0.09%
18	0.10%	0.09%	0.19%	0.53%	1.06%	0.79%	0.16%	0.10%	0.10%	0.13%	0.12%	0.09%
19	0.11%	0.09%	0.20%	0.52%	1.12%	0.74%	0.16%	0.10%	0.10%	0.13%	0.12%	0.09%
20	0.11%	0.09%	0.19%	0.51%	1.16%	0.68%	0.15%	0.09%	0.10%	0.15%	0.11%	0.10%
21	0.10%	0.09%	0.20%	0.56%	1.15%	0.66%	0.15%	0.09%	0.10%	0.14%	0.11%	0.10%
22	0.10%	0.09%	0.21%	0.61%	1.11%	0.61%	0.15%	0.09%	0.10%	0.13%	0.10%	0.10%
23	0.10%	0.09%	0.21%	0.71%	1.09%	0.58%	0.15%	0.10%	0.11%	0.12%	0.11%	0.10%
24	0.10%	0.09%	0.20%	0.69%	1.10%	0.54%	0.14%	0.09%	0.11%	0.12%	0.10%	0.10%
25	0.09%	0.09%	0.20%	0.64%	1.35%	0.52%	0.14%	0.09%	0.10%	0.13%	0.11%	0.10%
26	0.09%	0.09%	0.21%	0.64%	1.19%	0.50%	0.14%	0.09%	0.09%	0.12%	0.11%	0.10%
27	0.10%	0.09%	0.20%	0.59%	1.10%	0.46%	0.14%	0.09%	0.09%	0.12%	0.11%	0.10%
28	0.10%	0.09%	0.21%	0.58%	1.04%	0.43%	0.13%	0.09%	0.09%	0.12%	0.10%	0.10%
29	0.10%	0.09%	0.20%	0.60%	1.08%	0.40%	0.12%	0.09%	0.09%	0.13%	0.10%	0.10%
30	0.10%		0.21%	0.65%	1.02%	0.38%	0.11%	0.09%	0.10%	0.13%	0.10%	0.10%
31	0.09%		0.23%		0.98%		0.11%	0.09%		0.12%		0.09%

Table D-2. Daily Sediment TMDL for Bozeman Creek in tons												
Day of Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.50	1.68	1.61	4.22	10.11	15.47	5.86	1.86	1.54	1.43	1.97	1.68
2	1.57	1.54	1.57	4.57	9.54	15.76	5.54	1.82	1.50	1.47	1.97	1.68
3	1.57	1.50	1.64	4.43	9.58	16.19	5.25	1.89	1.39	1.50	2.04	1.68
4	1.47	1.54	1.72	4.00	10.61	15.47	5.07	1.89	1.32	1.57	2.00	1.68
5	1.54	1.57	1.68	4.32	10.54	14.94	5.04	1.82	1.39	1.72	1.97	1.68
6	1.54	1.68	1.64	5.29	11.72	15.19	4.65	1.86	1.50	1.79	1.89	1.68
7	1.47	1.57	1.64	4.97	13.01	17.12	4.43	1.82	1.54	1.82	1.97	1.64
8	1.64	1.57	1.86	5.00	13.54	16.47	4.22	1.86	1.47	1.82	2.22	1.54
9	1.57	1.50	1.93	5.32	13.44	15.72	3.86	1.93	1.54	1.86	2.14	1.54
10	1.50	1.50	2.00	5.61	13.58	15.83	3.64	1.86	1.79	1.86	2.00	1.57
11	1.47	1.50	2.07	5.54	13.33	18.33	3.61	1.75	1.61	1.86	2.00	1.64
12	1.50	1.50	2.50	5.86	13.33	17.90	3.47	1.64	1.47	1.89	2.00	1.64
13	1.54	1.50	3.14	6.50	13.47	16.62	3.36	1.61	1.50	1.86	2.04	1.61
14	1.57	1.50	3.14	7.79	14.44	15.58	3.22	1.61	1.50	1.86	2.00	1.61
15	1.54	1.47	2.86	8.29	15.69	15.01	3.00	1.68	1.54	1.97	1.86	1.61
16	1.50	1.47	2.86	7.58	15.79	14.44	2.89	1.57	1.50	2.11	1.97	1.54
17	1.57	1.47	2.89	8.18	16.58	13.94	2.79	1.57	1.57	2.18	1.93	1.50
18	1.64	1.47	3.07	8.54	17.29	12.83	2.68	1.68	1.61	2.11	1.89	1.47
19	1.82	1.50	3.18	8.40	18.19	11.97	2.61	1.64	1.57	2.11	1.89	1.54
20	1.72	1.43	3.14	8.25	18.87	11.08	2.43	1.50	1.57	2.36	1.86	1.57
21	1.68	1.47	3.32	9.08	18.69	10.68	2.36	1.47	1.64	2.25	1.75	1.61
22	1.57	1.47	3.36	9.97	18.05	9.90	2.36	1.47	1.68	2.07	1.68	1.57
23	1.57	1.47	3.36	11.58	17.69	9.43	2.39	1.61	1.72	2.00	1.72	1.64
24	1.57	1.47	3.22	11.26	17.87	8.83	2.22	1.54	1.75	2.00	1.64	1.57
25	1.54	1.47	3.18	10.36	21.98	8.47	2.25	1.47	1.64	2.04	1.72	1.61
26	1.54	1.50	3.39	10.47	19.30	8.15	2.29	1.47	1.54	1.97	1.79	1.64
27	1.68	1.54	3.32	9.65	17.94	7.47	2.25	1.39	1.50	1.97	1.72	1.57
28	1.64	1.54	3.39	9.51	16.97	6.97	2.18	1.39	1.50	1.97	1.68	1.57
29	1.57	1.47	3.25	9.79	17.51	6.54	1.97	1.47	1.50	2.04	1.64	1.64
30	1.61		3.47	10.54	16.65	6.25	1.82	1.47	1.57	2.04	1.68	1.57
31	1.54		3.72		15.87		1.79	1.54		2.00		1.54

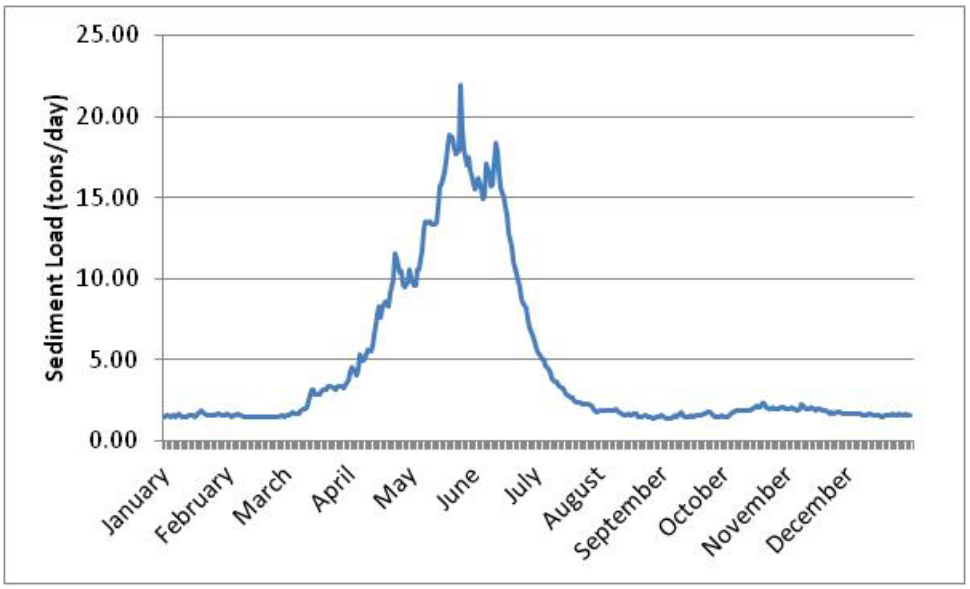

Figure D-1. Total Maximum Daily Load for Sediment in Bozeman Creek

Table D-3. TMDLs expressed as an average annual load and can be used in conjunction with the values in Table D-1 to compute daily loads.

Stream Segment	Waterbody #	TMDL Expressed as Average Annual Load (tons/year)
BEAR CREEK, headwaters to the mouth (Rocky Creek MT41H003_080)	MT41H003_081	501
BOZEMAN CREEK, Limestone Creek to the mouth (East Gallatin River)	MT41H003_040	1,625
CAMP CREEK, headwaters to the mouth (Gallatin River)	MT41H002_010	3,132
DRY CREEK, headwaters to the mouth (East Gallatin River)	MT41H003_100	4,684
GODFREY CREEK, headwaters to White Ditch	MT41H002_020	900
JACKSON CREEK, headwaters to the mouth (Rocky Creek)	MT41H003_050	700
REESE CREEK, headwaters to the mouth (Smith Creek)	MT41H003_070	1,531
ROCKY CREEK, confluence of Jackson and Timberline Creeks to mouth (East Gallatin River)	MT41H003_080	2,165
SMITH CREEK, confluence of Ross and Reese Creeks to the mouth (East Gallatin River)	MT41H003_060	2,159
STONE CREEK, headwaters to the mouth (Bridger Creek)	MT41H003_120	398
THOMPSON CREEK (or Thompson Spring), headwaters to mouth (East Gallatin River)	MT41H003_090	60